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Seasonal Food Habits and Intestinal Parasites of Black Bear *(Ursus americanus)* in western Manitoba

By Szalai, Alexander J. and Richard R.P. Stardom, 1987.

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Prepared by:

Richard Stardom

Approved by:

_____
Supervisor

Merlin W. Shoesmith
Section Chief/Director

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ABSTRACT

A study of black bears was conducted in the Duck Mountain area of Manitoba during the summers of 1979 and 1980. Stomachs, intestines and scats collected incidentally were analyzed for food habits and endoparasites in 1982. Comparison of techniques for analysis of the three digestive stages indicated that for general food habits, scats provided the most data for the amount of analysis time spent. Insects were the most important food source consumed overall, while green vegetation was a major component in spring and grain a major component in fall. The food item list for both male and female bears was similar but while females tended to have a more varied diet over time, the males appeared to ingest greater volumes of any particular item that was available. Incidence of endoparasites was similar for both sexes but abundance in females increased steadily during the active period while in males abundance peaked in summer, then declined toward fall.

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INTRODUCTION

The main purpose of this paper is to report on the food habit patterns and endoparasites of the black bears (Ursus americanus) taken from the Duck Mountain region of southwestern Manitoba. During the summers of 1979 and 1980, a collection of black bear stomachs, intestines, and scats was made by Walter Klenner (University of Manitoba Zoology Department).

As most black bear food habit studies work reported previously (Bennet et al. 1944, Hatler 1972, Landers et al 1979, and Tisch 1961) relied heavily on the analysis of fecal material for data, a proper comparison of the three major techniques of food habits analyses was in order. The data obtained from the analysis of stomachs, intestines, and scats were compared to assess the reliability of the three techniques.

The large sample sizes available provided a good opportunity to examine differences in the food habits of male and female black bears. Endoparasite data were examined. The hypothesis that sex of the black bear host altered the abundance, intensity, and prevalence of infestation was tested.

STUDY AREA

Food habits data were collected from a 6,000 km^2 area bordering on Duck Mountain (Fig. 1). The land from which samples were taken is representative of the entire 12,000 km^2 region shown as the "study area". Scats were collected from the Garland area in a region approximately 150 km^2 in size.

Table 1 lists plant species possibly used by black bear as food items in the study area. The list does not name all plants encountered but merely isolates those that have been shown to be used by black bears. Previous research by Landers et al. (1979) and Bennet (1944) establish the validity of the list.

MATERIALS AND METHODS

The specimen material used in this study included 126 stomachs, 76 intestines, and 195 scats collected during seasonal periods of bear activity in 1979 and 1980. Essentially, bear activity in western Manitoba begins in late February and continues until late October. This period is marked by three general seasons of plant food availability (Table 2).

During the first season, beginning when black bears emerge from their winter dens in early March and ending in late May, green vegetation is most abundant. Throughout the text of this paper this

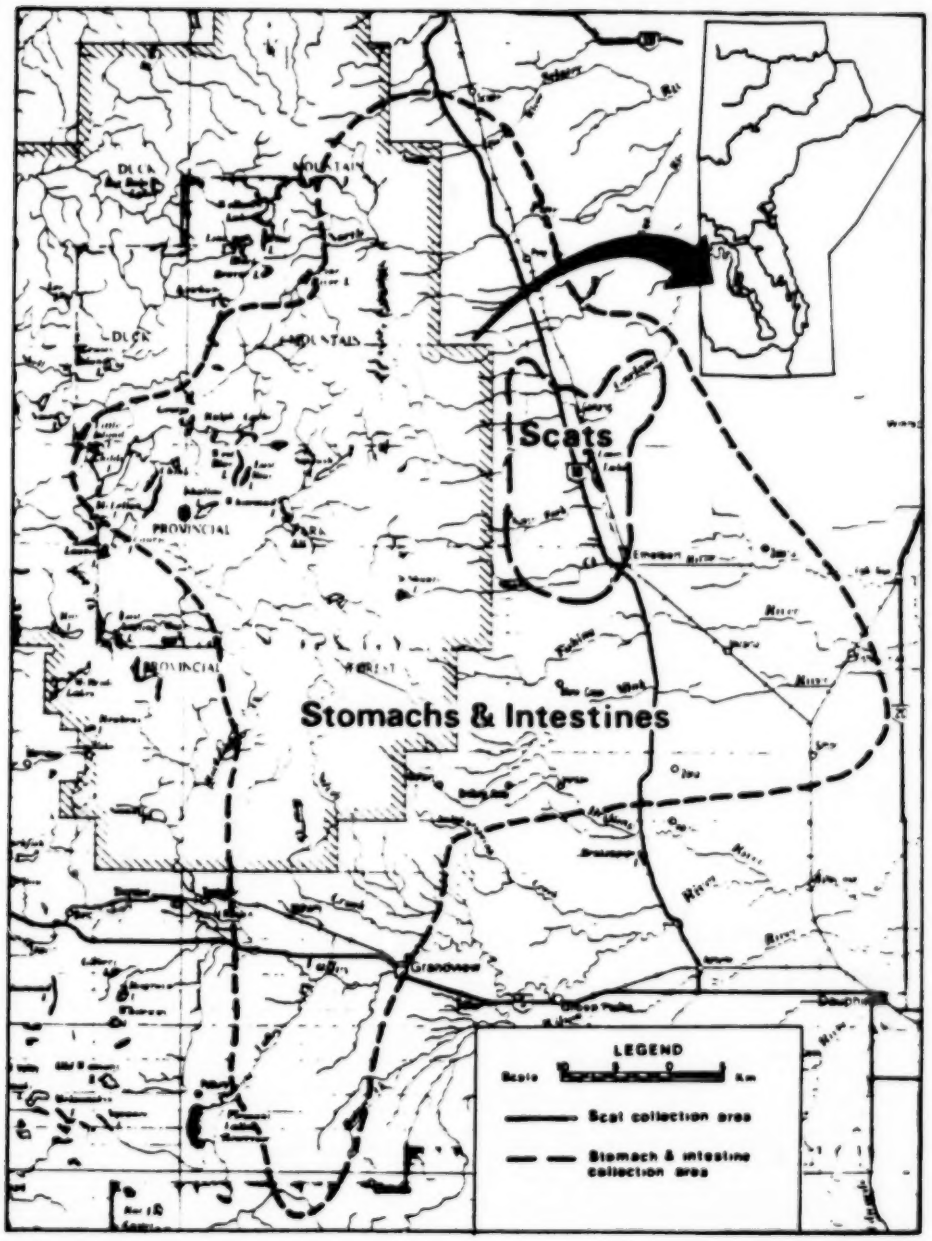


Figure 1: Duck Mountain study area showing areas of intensive sampling effort.

Table 1. Plant species possibly used as food items by black bear in the study area.

Family	Common Name	Scientific Name
Salicaceae	•Trembling Aspen	Populus tremuloides
	Balsam Poplar	Populus balsamifera
	Willow	Salix spp.
Fagaceae	Bur Oak	Quercus macrocarpa
Oleaceae	Green Ash	Fraxinus pennsylvanica
Rosaceae	•Pincherry	Prunus pennsylvanica
	•Chokecherry	Prunus virginiana
	•Wild Plum	Prunus americana
	•Serviceberry	Amelanchier alnifolia
	•Hawthorn	Crataegus rotundifolia
	•Prickly Rose	Rosa acicularis
	•Wood's Rose	Rosa woodsii
	•Wild Raspberry	Rubus idaeus var. strigosus
	Cloudberry	Rubus chamaemorus
	•Dewberry	Rubus pubescens
	•Wild Strawberry	Fragaria virginiana
Caprifoliaceae	•High-bush Cranberry	Viburnum opolus var americanum
	Nannyberry	Viburnum lentago
	Low-bush Cranberry	Viburnum edule
	Western Snowberry	Symphoricarpos occidentalis
	Snowberry	Symphoricarpos albus
	Twining Honeysuckle	Lonicera dioica var. glaucesens
Betulaceae	•Beaked Hazelnut	Corylus cornuta
Cornaceae	•Red-osier Dogwood	Cornus stolonifera
	Bunchberry	Cornus canadensis
Saxifragaceae	Skunkberry	Ribes glandulosum
	Northern Gooseberry	Ribes oxycanthoides
Eleaganceae	•Canada Buffaloberry	Shepherdia canadensis
Araliaceae	•Wild Sarsaparilla	Aralia nudicaulus
Ericaceae	Bearberry	Arcto staphylos uva-ursi
Vacciniaceae	•Blueberry	Vaccinium angustifolium
Liliceae	Star-flowered Soloman Seal	Smilacina stellata
	Three-leaved Soloman Seal	Smilacina trifolia
Balsaminaceae	•Jewell Weed	Impatiens capensis
Compositae	Dandelion	Taraxacum officinale
Lequminosae	•Alsike Clover	Trifolium hybridium
	Red Clover	Trifolium pratense
	White Clover	Trifolium repens
Lequminosae	American Vetch	Vicea americana
	Ascending Purple Milk Vetch	Astragalus striatus
	Alpine Milk Vetch	Astragalus alpinus
	Canadian Milk Vetch	Astragalus canadensis
	Alfalfa	Medicago sativa
Gramineae	•Oats	Avena sativa
	Wheat	Triticum aestivum
	Barley	Hardeum vulgare
	•Native Grasses	Gramineae
Cyperaceae	Sedges	Cyperaceae
Equisetaceae	Horsetails	Equisetum sp.

•Indicates species identified in scats, carcasses, or direct observations during feeding.

Table 2. Condition of some of the major fruits and berries in the study area in the various seasons of bear activity (Shewe 1979, personal comments).

Names	Date	Comments	Date	Comments
Rubus idaeus (Wild Raspberry)	May 30	leaves emerging	July 17	ripe fruit
	June 17	leaves mature	July 30	ripe fruit/flowers
	June 19	flowering	Aug. 15	ripe-fruit
Viburnum edule (Low-bush Cranberry)	June 7	leaves emerging	July 30	green fruit
	June 18	leaves & flowers mature	Aug. 15	ripe fruit
	June 23	flowers mature		
Viburnum trilobum	June 18	leaves, flowers	July 17	green fruit
	June 19	all flowers	Aug. 15	ripening fruit
	June 23	all flowers	Sept. 17	ripe fruit
Prunus americana (Wild Plum	June 18	leaves & flowers	July 31	ripe fruit
	June 23	green fruit	Aug. 15	ripe fruit
Ribes americanum (Black currant)	June 18	flowers & leaves	July 17	ripe fruit
	June 23	fruit	July 31	ripe fruit
Rubus pubescens (Dewberry)	June 7	flowers & leaves	July 17	ripe fruit
	June 18	flowers only	July 31	ripe fruit
Fragaria virginiana (Wild Strawberry)	May 30	leaves mature	June 23	flowers
	June 7	flowers	July 19	flowers & fruit
	June 18	flowers	July 30	flowers & fruit
Amelanchier alnifolia (Saskatoon)	May 30	leaf buds	June 23	berries forming
	June 12	flowers open	July 31	berries ripe
	June 19	all flowers	Sept. 28	leaves yellow
Lonicera dioica (Honeysuckle)	May 30	leaves out	July 7	flowers open
	June 7	leaves mature	July 17	flowers & fruit
	June 19	flower buds	July 31	fruit
	June 23	flower buds	Sept. 28	leaves yellow
Prunus pennsylvanica (Pincherry)	May 30	leaf buds	July 17	green fruit
	June 7	flowers	July 31	green fruit
	June 19	more flowers	Aug. 15	ripe fruit
	June 23	flowers out	Sept. 28	leaves yellow
Prunus virginiana (Chokecherry)	June 7	leaves, flower buds	July 17	green fruit
	June 18	flowers out	July 31	green fruit
	June 23	flowers all out	Aug. 15	ripe fruit
Rosa spp.	June 7	leaves mature	July 31	green fruit
	June 23	flowering	Aug. 15	ripe fruit
Ribes oxyacanthoides (Gooseberry)	June 7	leaves & flowers	July 31	ripe fruit
	June 23	green fruit		

season will be referred to as "spring". From early June when most fruit bearing trees are beginning to ripen is the "summer" season. "Fall", the final of the three seasons in which bears are active, lasts from the beginning of September to late October. By this time cereal grain crops have ripened and are being harvested in Manitoba. Grain and fruit become the major food supply and they last until the black bears once again enter their hibernating state.

Of the 397 samples analyzed, each season was equally represented. The data are therefore temporally distributed and bias does not affect seasonal data to any great extent.

Field Techniques: Stomachs and intestines were provided by hunter-killed or trapped bears from the study area. Many of the bears were killed as part of a depredation control program to protect local apiaries. The loss of 50 intestinal tracts can be attributed in some cases to scavengers, in some cases to damage, and in others to logistics.

Once removed from the carcass, each stomach was separated from its intestine by snipping the gut at the pyloric connection. Each intestine was tied shut at both the pyloric and anal ends to prevent massive loss of contents while handling. The stomachs were tied shut at both the pyloric and fundic apertures. In a few cases the stomach was not separated from the intestines, labelled and placed in a freezer until the current analysis was begun. The esophagus were discarded to eliminate the bulk of incidental material that a dying black bear inevitably swallows.

Scats were collected only if they could be accurately dated and recognized. The oldest scat sample was 9 days old; many others were fresh. Only in one instance was the ursid nature of a scat in doubt. Fecal droppings were bagged, separately labelled, and frozen until needed.

Lab Techniques: The first 22 stomachs analyzed were each emptied of their contents and any parasites found were isolated and stored in 250 ml jars of 10% buffered formalin. The remaining parasite-free contents of a stomach was then washed through 4 successively finer grades of screen (ranging in size from 1.699 mm to 425 um) with a strong jet of hot water. Whenever possible, individual items were separated out using forceps. Separation continued until only a homogeneous matrix remained. Of these 22 stomachs, the contents of four were separated still further by decanting in 10-12 cm of water. Once separation was complete, the isolated items were air-dried for 24 hours and weighed. This is the "dry-weight" method of food habits analysis.

The remaining 104 stomachs were analyzed using the simpler "percentage of total volume" technique. Each stomach was emptied into a shallow pan and again any parasites discovered were stored in formalin. The stomachs' contents were then mixed thoroughly and 3 samples of approximately 100 ml each were removed and placed in a second tray covered with a grid. The grid marked 25 equal-sized sections or "quadrats", each with a number from 1 to 25 associated to it in a random manner.

Next, the combined sample was uniformly distributed in the "grid-tray" by floating in about 2 cm of water. One of the 25 quadrats was selected at random and any items within its border recorded (with its associated estimate of the quadrats entire volume). When the first quadrat was completely searched, a second random quadrat was selected and analyzed in the same manner. Similarly, new quadrats were analyzed until no new food items were discovered. In most cases, an additional quadrat was then studied to test the accuracy of the procedure.

Stomach contents analyzed by the "dry-weight" method gave more quantitative data, but not sufficiently so as to warrant the extra time or resources involved.

Intestines were first cleared of any mesentery and fat that still remained, and then stretched out on a moistened bench to be snipped into 3 sections. That section nearest the stomach "front 1/3 of the intestine", next to it is the "middle 1/3 of the intestine". The extreme posterior section, ending in the anus, is the "rear 1/3 of the intestine".

The individual sections were then sliced open along their entire lengths using a pair of household shears. Food contents and parasites were then scraped away from the lumen and collected in a tray. Parasites were again stored in formalin, but a note was made as to how many and what type of parasites occurred in each section of the intestine. Intestine contents were then washed in a finely meshed pan to remove fat, bile, etc. Samples were then analyzed using the

percentage of total volume technique. The working area was continually moistened during analysis of the intestines. This made the handling of the tracts, some of which were over twelve metres long, much easier. Scats were also analyzed by the percentage volume technique.

In some cases, the entire contents of a stomach, intestine, or scat yielded less than 300 ml of material. In such instances the entire contents were analyzed. Ocular volume estimates for each individual quadrat were limited to 5 categories; Trace (less than 1%), 1-25%, 26-50%, 50-75%, 76-100%. Once the analysis of a sample was completed the final percentage volume for each item found was calculated by dividing the sum of all estimates for an item by the total number of quadrats tested for that sample.

Some samples had been stored at -12°C (-10°F) for over 2½ years, but only 24 hours was required for them to thaw completely. The condition of the samples was good, and there was no evidence of decomposition found in any case.

All examination was done macroscopically. Identification of fruits, berries, and vegetation were verified by comparison with collections made during the field seasons. Reference specimens from the Manitoba Department of Natural Resources were used to identify some mammal and bird remains. Parasites were identified to species by parasitologists at the University of Manitoba. Insects encountered needed no verification.

Kowal (1982) compiled a bibliography of publications on the black bear and it was often referred to as an aid in preliminary

research. Good publications on the techniques involved in food habits studies can be found in Korschgen (1980) and Wight (1939).

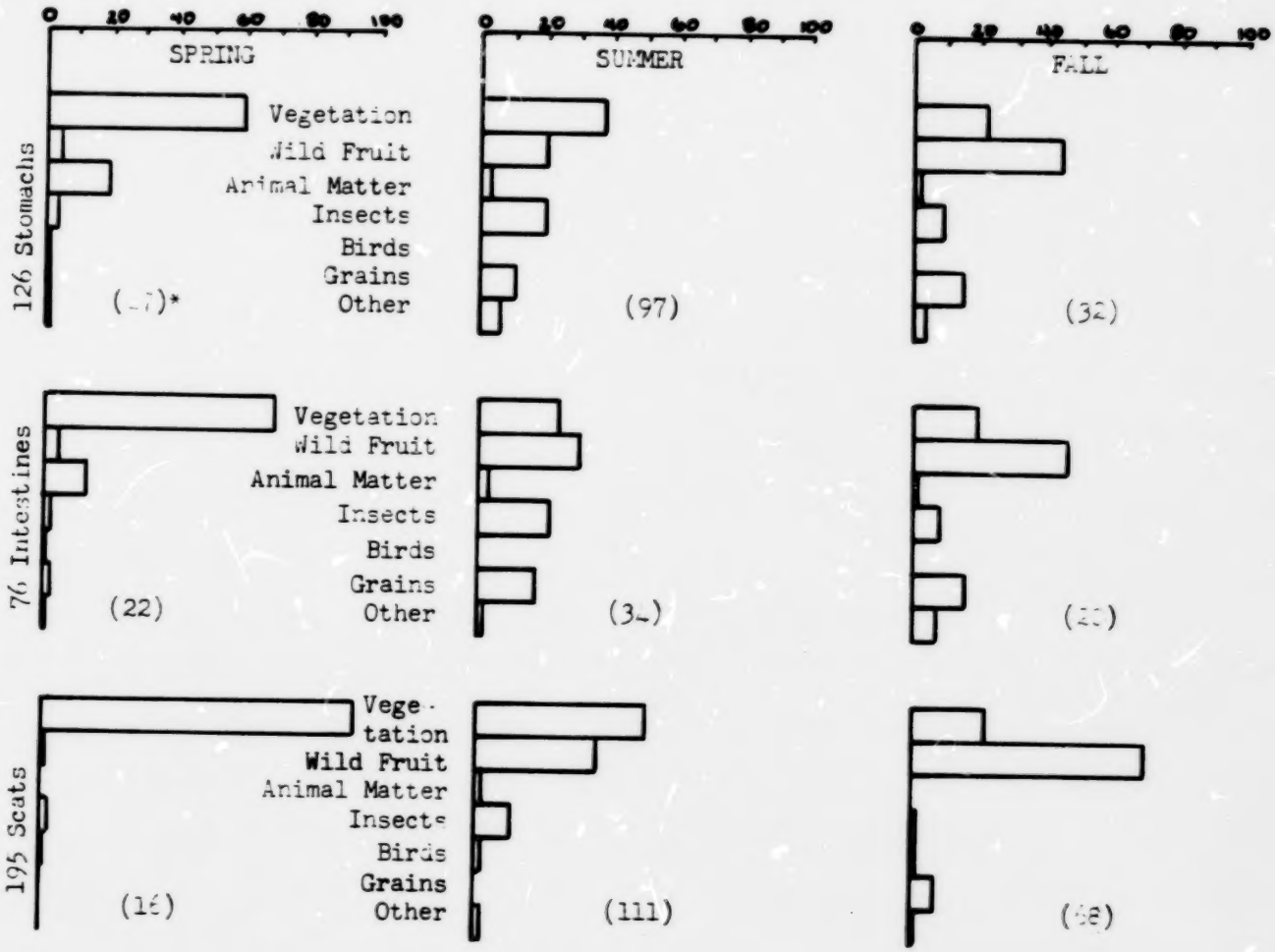
RESULTS

Food Habits

Figures 2 and 3 depict the relative importance of the major food categories by aggregate percentage volume and frequency of occurrence respectively (Appendix I). Tables 3 and 4 provide a seasonal comparison of frequency of occurrence, and also give information on individual food items found in stomachs, intestines, and scats. Figures 4 and 5 give information on both sexes of black bears and their respective food habits.

Hatler (1972) was the first to use intestines in the study of black bear food habits and we agree with him that "intestines are inconvenient to transport and store and quite messy to work with". The intestinal contents were of low volumes in most cases, but when correlated with stomach and scat contents one can analyze the changes in various food items that occurred on passage through the gastrointestinal tract.

Green vegetation changes least. Plants are still easily identified to species even in scats. Fruits have a wide range of durability. Chokecherries, in many cases, were passed in scats as intact berries and therefore suffered little volume change. Sarsaparilla, complete in the stomach, was broken down in the intestine until only fragmented seeds remained in the scat. In this case



*Numbers in brackets indicate number of samples analyzed.

Fig. 2. Overall aggregate percentages of food items in stomachs, intestines and scats by season.

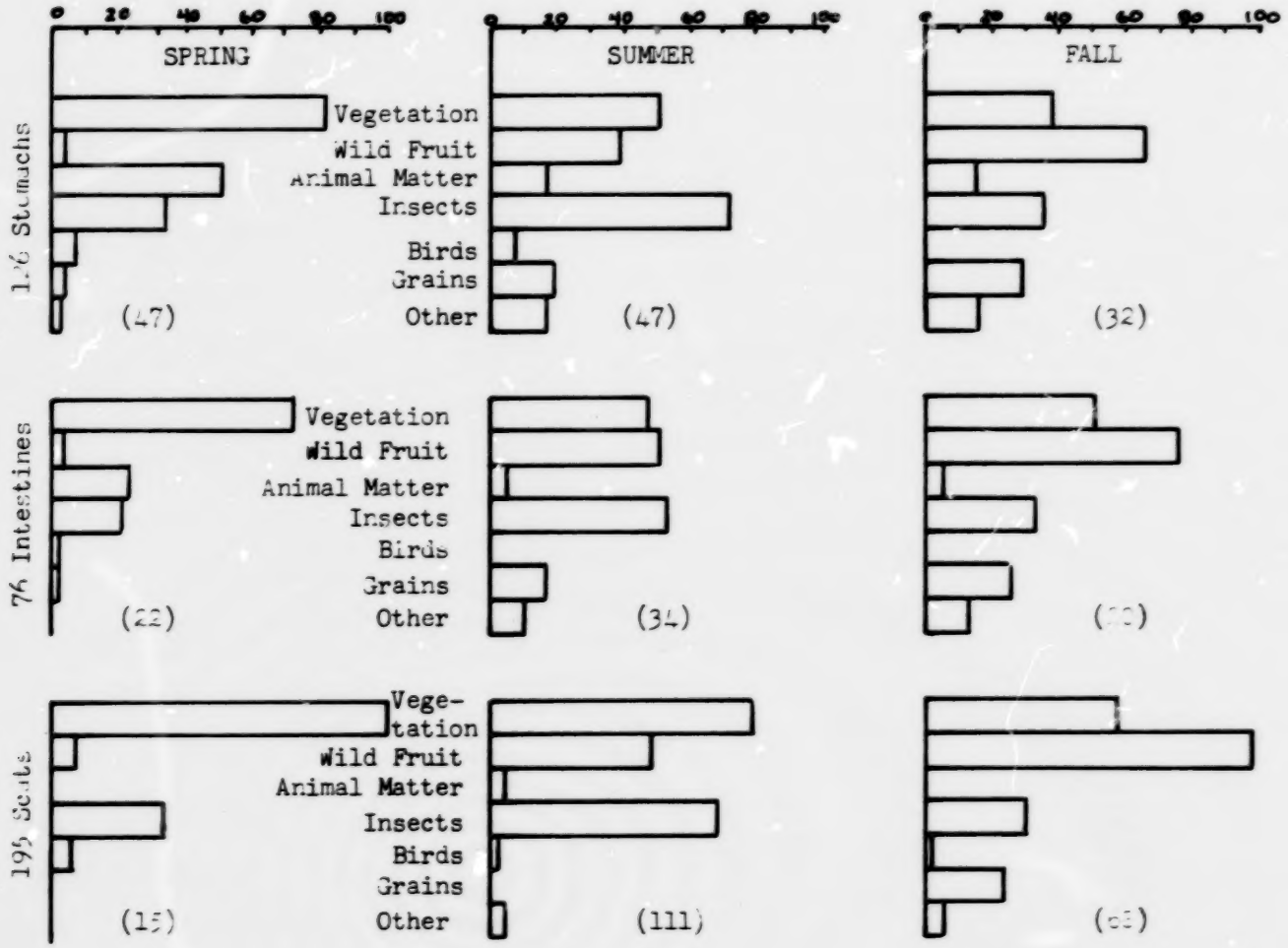


Fig. 3. Relative frequency of food items in stomachs, intestines and scats by season.

Table 3. Frequency of occurrence for stomach, intestine, and scat contents.

	SPRING							SUMMER						
	Stomachs			Intestines			Scats	Stomachs			Intestines			Scats
	Fem.	Male	Comb.	Male	Fem.	Comb.		Fem.	Male	Comb.	Fem.	Male	Comb.	
Green Vegetation	72.4	90.2	81.3	64.3	78.8	71.5	100	23.4	83.4	50.4	44.4	50.0	47.2	78.6
Wild Fruits	3.4	4.8	4.1	ø	7.1	3.6	6.7	44.4	33.3	38.6	44.4	60.0	50	48.2
Animal Matter	44.8	56.1	50.4	14.3	32.1	23.3	ø	22.2	11.1	16.7	11.1	ø	5.6	5.4
Insects	34.5	31.7	34	28.6	14.3	21.5	33.3	77.7	66.7	72.1	56.5	50.0	53	68
Birds	3.4	9.7	6.6	ø	3.6	1.8	6.7	ø	16.7	8.4	ø	ø	ø	2.3
Grains	ø	7.3	3.7	ø	3.6	1.8	ø	11.1	27.8	19.4	33.3	ø	16.6	ø
Other	6.9	ø	3.6	ø	ø	ø	ø	16.7	16.7	16.7	22.2	ø	11.1	4.8

	FALL							AVERAGE						
	Stomachs			Intestines			Scats	Stomachs			Intestines			Scats
	Fem.	Male	Comb.	Fem.	Male	Comb.		Fem.	Male	Comb.	Fem.	Male	Comb.	
	22.2	54.5	38.4	33.3	66.7	50	57.4	39.3	76	56.7	47.3	65.1	56.2	78.1
	66.6	63.6	65.1	83.3	66.7	75	97.1	38.1	33.9	35.7	42.6	42.8	42.8	50.7
	11.1	18.2	14.6	ø	11.1	5.6	ø	26	22.4	11.8	8.5	18.1	11.5	1.8
	33.3	36.3	34.8	ø	66.7	33.4	30.9	48.5	44.9	46.9	28.4	43.6	35.9	94.1
	ø	ø	ø	ø	ø	ø	2.9	1.1	8.7	5.0	ø	1.2	T	3.9
	22.2	36.3	29.2	16.7	33.4	25	23.5	11.1	23.8	17.4	16.7	12.3	14.3	7.8
	22.2	9.1	15.6	16.7	11.1	13.9	5.9	15.3	8.6	11.9	12.9	3.7	8.3	3.6

Table 4. Aggregate percentages for scat contents.

	Common Name	Scientific Name	SPRING	Total	SUMMER	Total	FALL	Total
VEGETATION	Grasses	Graminoae	39.7		17.0		T	
	Mulch		46.7		22.5		19.3	
	Poplar	Populus tremuloides	3.3		1.3			
	Willow	Salix spp.	T	93.6	1.5	50.4	T	21.3
	Clover	Trifolium spp.			T		T	
	Dandelion	Taraxacum officional	3.2		7.2			
	Horsetail	Equisetum spp.						
	Honeysuckle	Lonicera diocia			1.2			
WILD FRUITS	Cranberry	Viburnum oppolus			T		20.5	
	Rosehips	Rosa sp.			T		T	
	Chokecherry	Prunus virginiana			1.8		14.4	
	Hazelnut	Corylus cornuta					1.2	
	Dogwood	Cornus stolonifera			8.2		24.1	
	Sarsaparilla	Aralia nudicaulus			18.3		2.0	
	Saskatoon	Amelanchier alnifolia	T		1.7		T	
	Strawberry	Fragaria virginana			T			
	Nannyberry	Viburnum lentago					T	
	Buffaloberry	Shepherdia canadensis		T	1.8	36.0		70.1
	Wild Plum	Prunus americana					3.3	
	Blueberry	Vaccinum spp.						
	Snowberry	Symphor icarpos spp.					T	
	Bunchberry	Cornus canadensis						
	Pincherry	Prunus pennsylvanica					T	
	Hawthorn	Crataegus rotundifolio					1.6	
	Raspberry	Rubus idaeus			3.4		T	
ANIMALS	Beaver	Bait Castor spp.			T			
	Beef	Bait			T			
	Flesh							
	Muskrat			T		2.0		T
	Pork							
	Moose	Alces alces			T			
INSECTS	Ants	Formicidae	1.0		7.4		T	
	Wasps	Vespidae			T		T	
	Bees	Vespidae			T		T	
	Beetles	Coleoptera	1.0	2.0	T	10.4	T	1.0
	Larvae							
	Crickets				T			
	Blackfly				T			
BIRD	Birds		T	T	T	T		T
GRAIN	Oats	Avena sativa					4.2	
	Wild Oats			T		T	1.5	6.9
	Barley	Hordeum vulgare					2.2	
	Corn							
OTHER	Unidentified				T			
	Honey +/- Wax				T		1.0	
	Inorganic			T	T	1.0		1.0
	Snails	Crustacea						
	Mushrooms	Fungi						

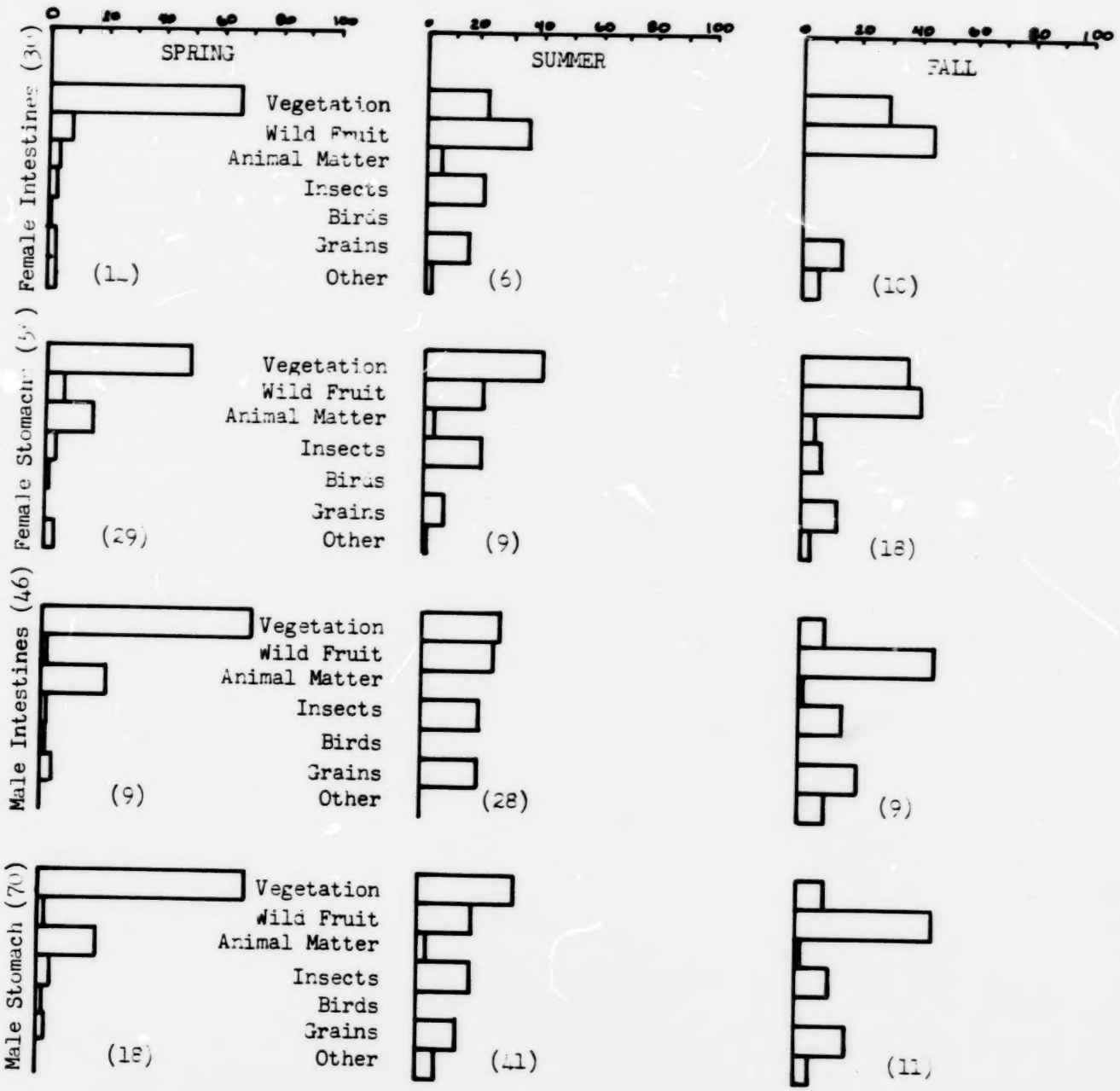
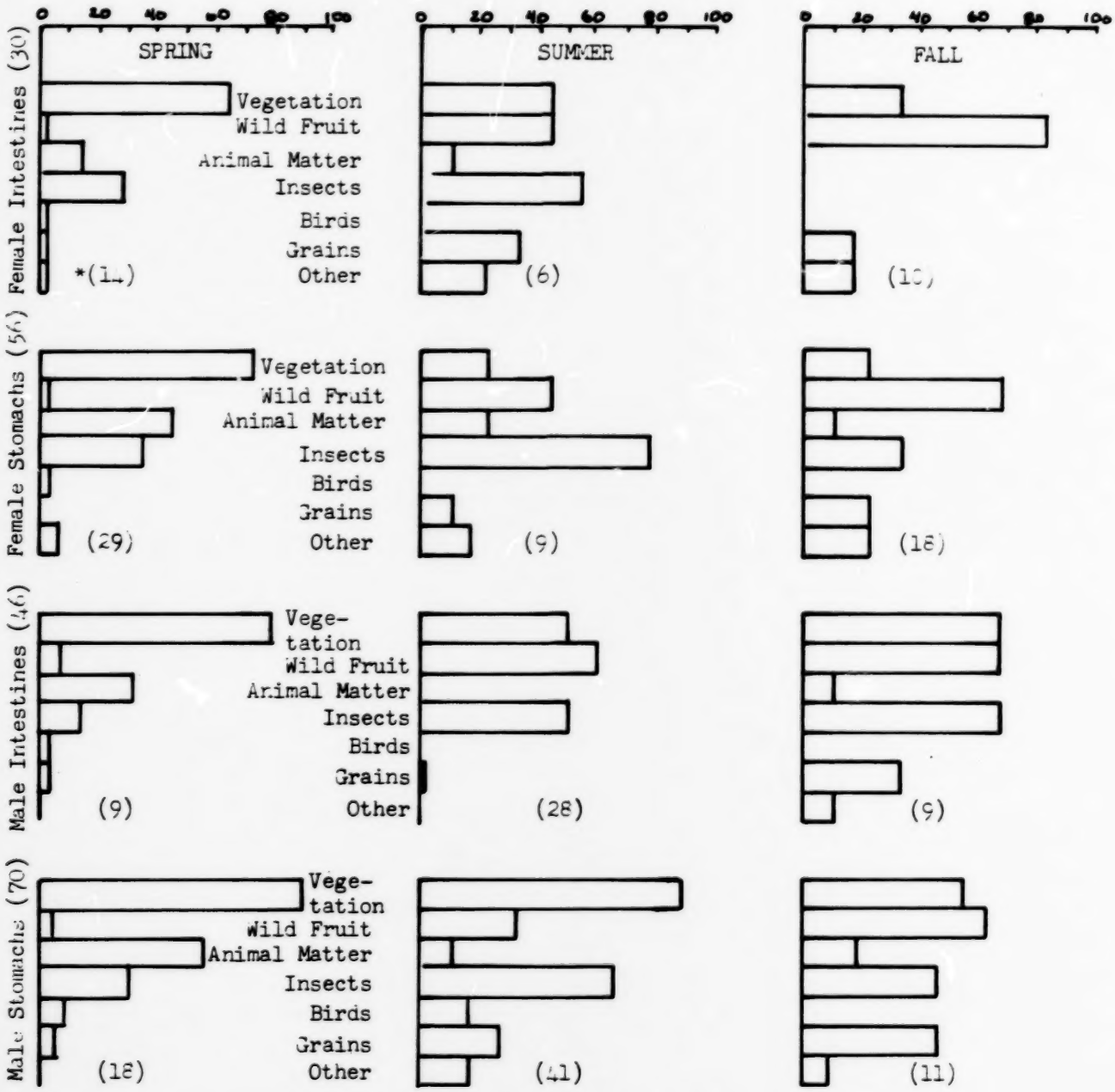


Fig. 4. Aggregate percentages of food items in stomachs and intestines by season and sex of bears.



*Numbers in brackets indicate number of samples studied.

Fig. 5. Relative frequency of food items in stomachs and intestines by season and sex of bear.

the volume changes are drastic and will affect the data. Overall, the volumes of food items in scats are less than in both stomachs and intestines and this results in lower than expected values.

Only the hard parts of animals - claws, hooves, beaks, bone, feathers, tails, and cartilage appear in the intestines and scats. Flesh is totally digested in the stomach. Identity is not lost but again volumes change drastically.

Insects, grains, and debris produced stable volume estimates throughout the gastrointestinal tract and even in the scats. This is probably due to their low initial water content and durability.

Scat analysis is the simplest of the three methods. Using the percentage volume method it took 15-20 minutes to totally analyze a scat, whereas intestines and stomachs took 30-40 minutes and 20-30 minutes to analyze, respectively.

Green vegetation

Plant material proved to be the most important component of the spring diet of black bears in western Manitoba. Many native grasses (Gramineae) are taken but dandelion (Taraxacum officinale) and horsetails (Equisetum spp.) represented a much larger proportion of green plants chosen by bears for food. Dandelion seeds and leaves even appeared in trace amounts in some scats, but not in the fall. Other green plants such as alfalfa (Medicago sativa), honeysuckle (Lonicera dioicia), sedges (Cyperaceae), and clover (Trifolium spp.) also appeared frequently throughout the year but in low volumes. The needles of pine (Pinus spp.) and willows (Salix spp.)appeared in high frequency but low percentages suggesting that they had been ingested incidentally during grazing or at the time of capture.

Fruits

The importance of wild fruits in the diet of the black bear is evident in the summer months. As the year progresses not only the frequency of occurrence but the volume of fruits taken as food increases. By the fall season, fruit and berries outweigh all other items in importance. Of the many different kinds of fruit available to the black bear in the study area (Table 1), four are most valued by bears as a food source; high-bush cranberry (Viburnum opulus var. americanum), dogwood (Cornus stolonifera), chokecherry (Prunus virginianus), and sarsaparilla (Aralia nudicaulis). Cranberries very often remain on their bushes throughout the winter and as a result, appear in a higher than expected number of carcasses and scats in the springtime. Throughout summer and fall, these four major fruits are preferred by the black bear over all others.

When available however, hazelnuts (Corylus cornuta), saskatoon (Amelanchier alnifolia), and wild plum (Prunus americana) are eaten in large amounts. The fruits of rose (Rosa spp.) appear at trace levels year-round while those of strawberry (Fragaria virginiana), nannyberry (Viburnum lentago), buffaloberry (Shepherdia canadensis), and snowberry (Symphoricarpos spp.) appear less often, usually in late fall when other fruit supplies have been exhausted.

Animal matter

Most of the vertebrate remains found originated from baits used by trappers. While not a normal part of a black bear's diet, baits cannot be overlooked because there are several features of

interest. Beaver (Castor candensis) flesh was the most often occurring bait meat in samples analyzed, but since beaver was used as bait more often than other baits we cannot conclude that black bears prefer beaver over beef, pork, or bear (the other bait meats used by trappers and hunters in the study area). In two cases however, the data show that beaver remains were found in bears that had not been baited, suggesting that beaver are taken as a normal part of their diet.

Surprisingly, bear flesh itself was used successfully as a bait. However, cannibalistic tendancies can be ruled out by reports in the field data that the carcass in question was in poor condition due to starvation.

Snowshoe hare (Lepus americanus) appeared quite frequently as carrion and in some cases not. The ears and hooves of a moose (Alces alces) calf, and the hide and hooves of a deer (Odocoileus virginianus) fawn were found in separate samples. In another sample the maggot-infested remains of another moose were discovered. Rodents of all types were taken with muskrats (Ondatra zibethicus) and squirrels (Citellus spp.) outnumbering all other species. Fish appeared occasionally but identification to species was not practical.

Insects

Insects of the order Hymenoptera constituted a large proportion of the summer diet. Adults, eggs, and pupae of ants (Formicidae) and bees (Vespidae) occurred frequently. In scats, beetles (Coleoptera) were often isolated but they were most likely incidental, having been included with the scat during collection in the field.

Birds

Birds made up an insignificant volume of the bears diet, but they were taken throughout the year. The feet and talons, bones, and feathers were most often found. Grouse (Tetraonidae) and sparrows (Zonotricha spp.) were taken often in the spring. In addition, one carcass contained a single webbed foot of a Canada goose (Branta canadensis).

Grain

Cereal grains were unimportant in the spring but in the summer and fall they became an important part of the black bear's diet. Oats (Avena sativa) and wheat (Triticum aestivum) were preferred, but barley (Hordeum vulgare) and corn (Zea mays) were also consumed when available.

Other

Garbage discarded by humans and debris injested incidentally during normal grazing activities were taken most frequently in the summer and fall, but even then they were relatively unimportant as food when compared to the other food categories. In the few bears that did feed on garbage, almost the entire meal was of this material. Paper, honey, and beeswax appeared in those carcasses that contained bees. This indicates that the entire hive of a wasp or honeybee colony was eaten by an intruding bear rather than just the bees themselves. Gravel and wood pulp were frequent but sparse, while a single sample contained a length of barbed fence wire. That the bear swallowed the length of wire without hurting itself on the barbs is amazing.

There is no appreciable difference between the diets of male and female black bears in terms of what species they eat. However, the frequency of occurrence for most food categories was lower in male bears than the corresponding food category in female bears. Volume, on the other hand, was usually higher in males. This can be interpreted to mean that females have a more mixed diet. That is, a male black bear will gorge itself on what few species are available. On the other hand a female will have some of every species it can find to eat. This is just an assumption and cannot be proven by this report, but nevertheless does suggest that the diet of male black bears is dissimilar to that of female black bears.

Endoparasites

Of the 126 stomachs and 76 intestines studied, only a single stomach and 24 intestines contained parasites. In total, 254 individual parasites were found, of which only one was a cestode (Dyphyllobothrium ursi). The rest were nematodes (Gongylonema pulchrum).

The intensity of infection (numbers of parasites per infected host) remains relatively steady throughout the black bear's active period, but the value for males in the study area is slightly higher. Abundance (number of parasites per host) in female carcasses steadily increased as the year progressed, but in male carcasses the abundance reached a maximum in summer and declined towards fall (Fig. 6). Average yearly abundance was about equal for both sexes.

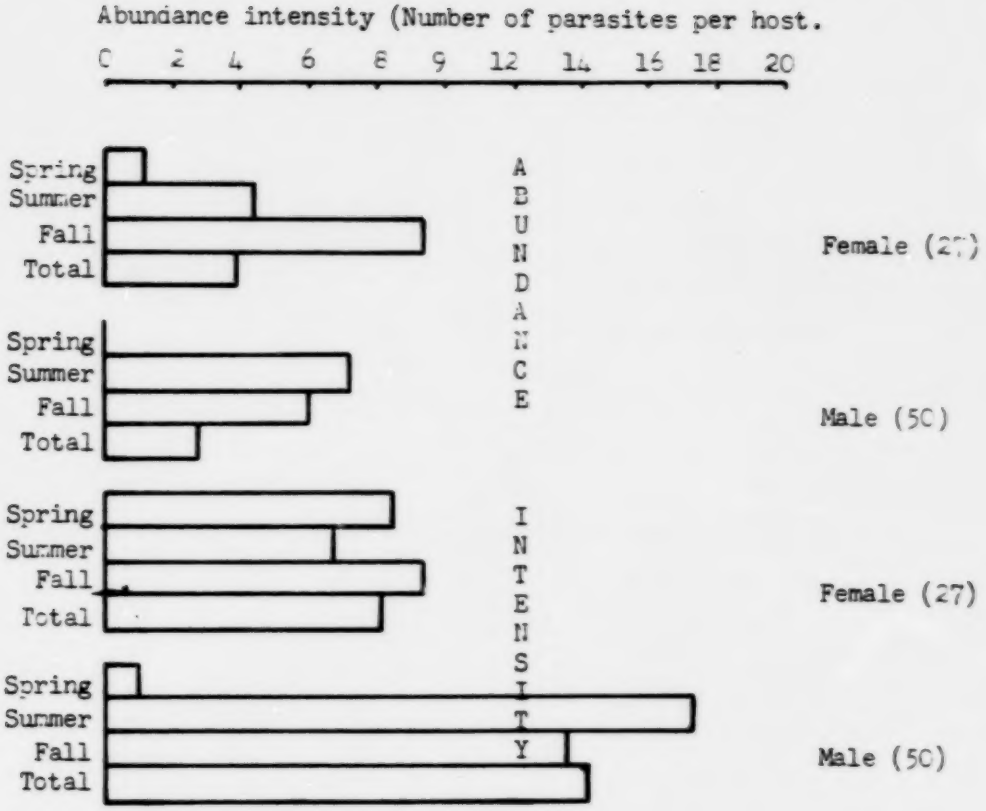


Fig. 6. Abundance and intensity of parasitism by season and sex of bears.

This may indicate that fewer males were infected, but those that were had a higher level of parasites than infected females. Prevalence showed the same pattern in both female and male samples; lowest values were found in the spring and they increased until prevalence reached a maximum in the fall [(Fig. 7), (Appendix IIa)]. Overall, the prevalence in females is higher than in males. Site specificity was the same in both males and females (Fig. 8), with most of the parasites found in the front 1/3 of the intestine [(Fig. 8), Appendix II b)]. As mentioned previously only one stomach was found to contain parasites.

DISCUSSION

Food Habits

The importance of green vegetation in the spring diet of black bears in southwestern Manitoba is consistent with reports from other areas. The individual species involved, however, differ from study to study. Horsetail was also an important spring food item in Montana (Tisch 1961). Hatler (1972), Chatelain (1950), Bennet et al. (1944) and Landers et al. (1979) all report similar findings. Leaves and stems appeared more important than roots and bulbs to the black bears in this study.

Like Hatler (1972), we found that animal matter as food is not prerequisite in the diet of the black bear. Deer and moose, taken infrequently, were usually carrion in nature. As mentioned earlier, however, it appeared that some bears had actively obtained deer and

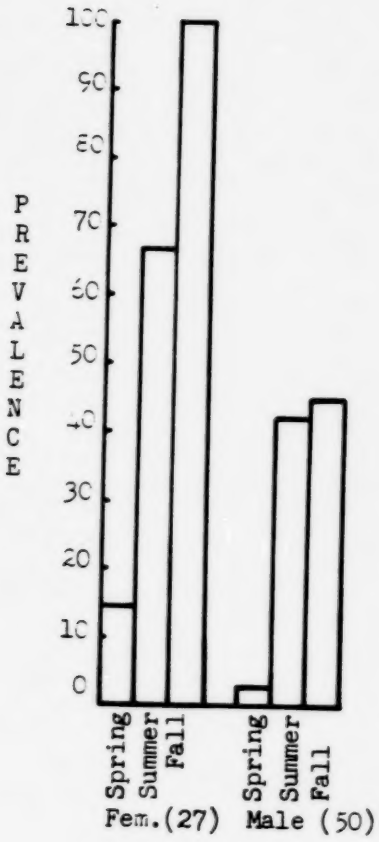


Fig. 7. Prevalence of parasitic infection by season and sex of bear.

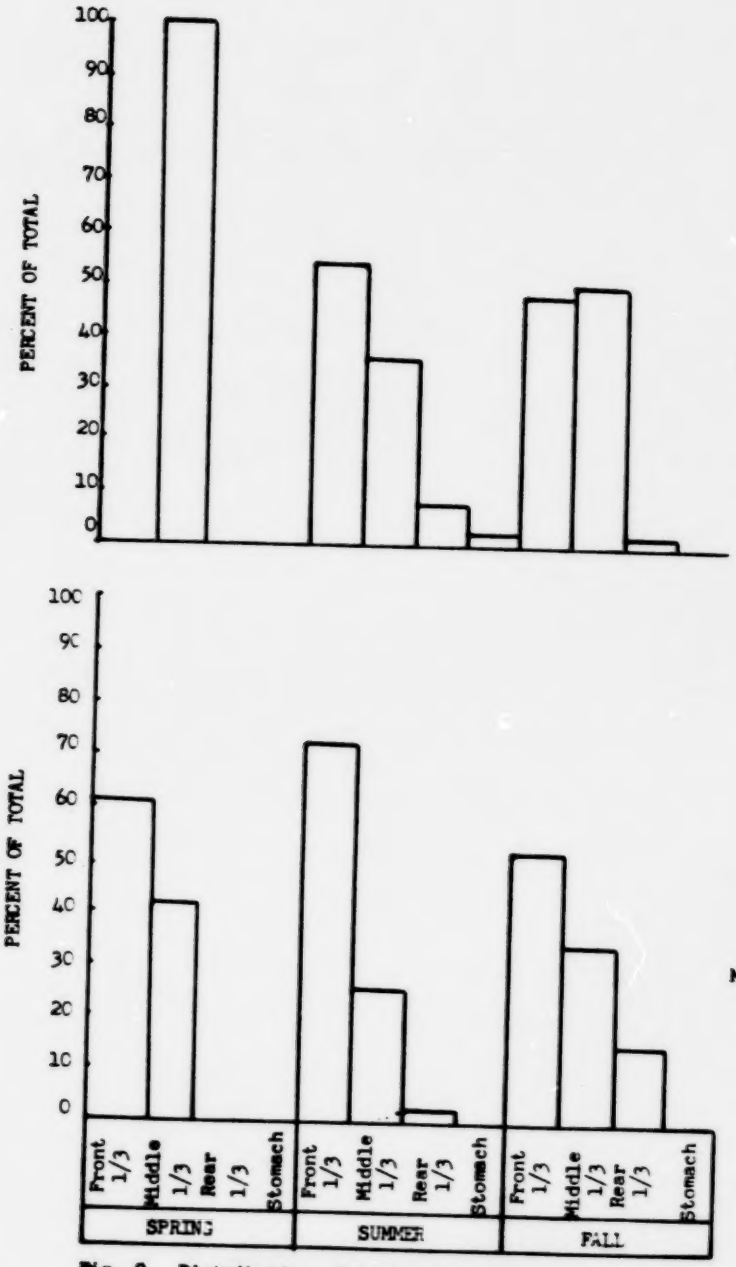


Fig. 8. Distribution of intestinal parasites.

moose for food by hunting them. Bennet et al. (1944), King (1967), and LeResche (1968) have all reported that moose calves and deer fawns have been taken actively by black bears as a food source. In April of 1974, Behrend and Sage (1974) reported that they had witnessed a black bear kill an adult white-tailed deer so predation on members of the deer family by black bears in the study area seems very likely. Hatler (1972) found that the use of the snowshoe hare as a food item by bears is closely related to their "cycle". In this study no information was available regarding the cycle's stage in the study area for 1979 and 1980. Nevertheless the frequency of hares taken does indicate they are an important food source.

Insects are by far the most important food source in terms of frequency and volume. Chatelain (1950) showed similar results with black bears from the Kenai Peninsula. Hatler (1972) concluded that "a concentration of insects is a necessary prerequisite to use of these creatures as food by bears", and this report can only support his statement. The colonial nature of ants and bees, and the continued presence of nest material taken incidentally all indicate that Hatler's assumption is correct.

Though no previous reports were found of grouse being used as a food source by black bears, data from other food analyses indicate that grouse may be actively killed for food. In this study most grouse remains were found in spring samples. It is possible that these birds were taken during their mating season when predation is more successful or that these birds were ones which had died over winter.

Sparrows and other small songbirds also provided this ursid with a nutrient source. In a single sample egg shells were found suggesting that the bear had robbed a nest. DeWeese and Pillmore (1971) reported the robbery of Red-Shafted Flicker (Colaptes cafer) nests by black bears, and Morlan (1972) reports that bears have robbed the nests of Bank Swallows (Riparia riparia). In both cases eggs were taken as food.

The importance of grain as a food source to black bears is largely due to man's farming activities. Western Manitoba is largely agricultural and the deforestation of land to make way for increased growing acreage has changed the habitat of the study area. In some areas where farming is concentrated, the supply of other food items such as fruits and native grasses is cut short. Black bears, however, are very adaptable and have turned to the grain itself to fulfill their dietary requirements. Some bears examined had gorged on oats and wheat, while others had only low volumes of grain ingested. It is apparently a matter of preference, and the use of grains for food is not consistent from one bear to another.

As previously suggested, Manitoba black bears make consistent use of four or five fruits and occasional use of several others. This find is consistent with the results of other analyses like that of Tisch (1961).

The nature of black bears in the study area is perhaps best described as "opportunistic and omnivorous", a phrase coined by Hatler (1972). A black bear will eat almost anything that presents itself.

It is because of this opportunistic nature that the diets of individual bears can be so different. Seasonal food availability has an unprecedented impact on the ursid diet. Whatever species is most abundant in a season is usually taken most often. Preference, however, also plays a minor role in the control of a black bear's diet. Of all green plants taken, dandelions and horsetails were preferred over all others. The same situation held true for animals; beaver proved to be the bears "favourite" type of vertebrate food.

Based on the results of this study, it is our opinion that a quick, accurate study of black bear food habits can be made using a good collection of scats. If more accuracy is preferred, stomachs must be examined also. Intestines, however, should only be analyzed in food habit studies if a detailed look at food processing is to be considered. Otherwise, intestine analysis provides too little data to warrant the extra time and work involved.

Endoparasites - Even though the number of samples collected was adequate, the data may be incomplete due to the extended preservation time. Some of the gastrointestinal tracts had been preserved for over 2½ years, and it is doubtful that anything but the hardiest parasites would remain intact for that long. This may explain the almost total lack of cestode parasites, as mentioned earlier only one cestode was found but it was over 12 metres long! The intensity of infection in male carcasses was close to double the intensity of infection in female bears. This is most likely due to the greater length of intestine

found in the male bears, providing more space for parasites. Males, however, were healthier than females in respect to prevalence throughout the year. Why female black bears are more susceptible to infection by parasites is unknown but nevertheless the data indicate that they are.

In all carcasses examined, although pathogenic effects of parasitism were not evident, the consequences of infection were apparent. One carcass containing 56 parasites was reportedly "in poor condition, covered with numerous ticks" at the time it was shot.

From a public health standpoint, parasites of black bears in the western portion of Manitoba appear to be of little consequence with the possible exception of trichinosis. Trichinella spiralis was not detected in the carcasses we examined, but the diaphragms were not usually included with the gastrointestinal tract and therefore trichinosis could not be ruled out. For a good summary of the major parasites of the black bear see Crum et al (1978).

LITERATURE CITED

Behrend, D.F., and R.W. Sage. 1974. Unusual feeding behaviour by black bears. J. Wildl. Manage. 38(3): 510

Bennet, L.J., P.F. English, and R.L. Watts. 1944. The food habits of the black bear in Pennsylvania. J. of Mammalogy 25(1): 25-31.

Chatelain, E.F. 1950. Bear-moose relationships in the Kenai-Penninsula. North American Wildlife Conference Transactions 15: 224-233.

Crum, J.M., V.F. Nettles, and W.R. Davidson. 1978. Studies on endoparasites of the black bear (Ursus americanus) in the southeastern United States. J. of Wildl. Dis. 14: 178-185.

DeWeese, L.R., and R.E. Pillmore. 1971. Bird nests in an aspen tree robbed by black bear. Condor 74(4): 488.

Hatler, D.F. 1972. Food habits of black bears in interior Alaska. The Can. Field Nat. 86(1): 17-31.

King, D. G. 1967. A black bear kills a fawn. The Can. Field Nat. 81(2): 149-150.

Korschgen, L.J. 1980. Procedures for food-habits analyses. (In) Wildlife Management Techniques Manual. 4th Ed. (revised) chapter nine.

Kowal, E.H. 1982. A bibliography of publications on black bears (Ursus americanus). Department of Northern Saskatchewan, Resource Branch, Wildlife Division.

Landers, J.L., B.J. Hamilton, A.S. Johnson, and R.L. Marchinton. 1979. Food habitats of black bears in southeastern North Carolina. J. Wildl. Manage. 43(1): 143-153.

LeResche, R.E. 1968. Spring-Fall calf mortality in an Alaskan Moose population. J. of Wildl. Manage. 32(4): 953-956.

Morlan, R.E. 1972. Predation at a northern Yukon Bank Swallow colony. The Can. Field Nat. 86: 376.

Tisch, E.L. 1961. Seasonal food habits of the black bear in the Whitefish range of northwestern Montana. Unpublished M.S. Thesis, University of Montana, Missoula. 108 p.

Wight, H. M. 1939. Food habits research. Chapter VII in Field and Laboratory Technic. University of Michigan Press. 1939.

APPENDIX I

APPENDIX I. Aggregate percentages for stomach and intestine contents.

Common Name	Scientific Name	Class	SPRING										SUMMER									
			STOMACHS					INTESTINES					STOMACHS					INTESTINES				
			Fem.	Male	Fem.	Male	Ave.	Fem.	Male	Fem.	Male	Ave.	Fem.	Male	Fem.	Male	Ave.	Fem.	Male	Fem.	Male	Ave.
Pine	Pinus spp.	VEGETATION	4.8	6.4				8.9	7.5				T									
Pulp			1.3	T				6.0						T								
Grasses	Gramineae		7.5	14.5				13.9	14.4				16.5	17.3				2.2	16.0			
Mulch			25.8	19.1				32.1	27.8				13.6	8.8				12.2	10.0			
Poplar	Populus tremuloides		3.2	4.8				1.4	T				3.9	2.6				4.0				
Willow	Salix spp.		4.1	11.6	49.5	70.2	59.7	T	8.8	66.2	72.2	69.15	3.2	T	41.2	33.1	27.1	2.4		20.8	27.0	23.9
Clover	Trifolium spp.												T	1.0								
Dandelion	Taraxarum officinale		2.8	5.1				2.9	1.1				T	1.4					T			
Horsetail	Equisetum spp.			5.7					11.6				T									
Sedges	Cyperaceae			T																		
Honeysuckle	Lonicera dioica																					
Alfalfa	Medicago sativa			T																		
Cranberry	Viburnum opulus	WILD FRUITS	3.4					4.0					1.8	2.9				10.1	5.5			
Rosehips	Rosa spp.		T	T				T					T	T				T				
Chokecherry	Prunus virginiana												1.7	2.5				5.0	1.0			
Hazelnuts	Corylus cornuta												2.9	T				6.1	T			
Dogwood	Cornus stolonifera		T					T					11.6	6.1				12.6	13.5			
Sarsaparilla	Aralia nudicaulus				6.4	2.0	4.2			7.0	2.0	4.5	T	4.5	20.0	20.0	20.0		2.5	34.8	24.5	29.7
Saskatoon	Amelanchier alnifolia		T					T	T										1.0			
Strawberry	Fragaria virginiana			T					T													
Nannyberry	Viburnum lentago																		T			
Buffaloberry	Shepherdia canadensis													T								
Wild Plum	Prunus americana													T								
Muskrat	Ondatra zibethicus	ANIMALS	2.2																			
Squirrel			2.3						3.2				3.0					3.0				
Rabbit	Lepus americanus		2.8	3.5																		
Fish			T						T													
Pork	Bait		3.5	T	15.9	20.5	18.2	2.5		3.5	21.4	12.5	T	T	4.0	3.0	3.5	2.4		5.4	ø	2.7
Bear	Bait/Grooming		T	T																		
Beaver	Bait (Castor spp.)		3.0	11.6					12.7													
Beef	Bait		T	1.0				T	4.7													
Moose	Alces alces			1.4																		
Deer	Odocoileus spp.													T								
Ants	Formicidae	INSECTS	3.2	1.1				3.0	1.6				16.3	16.4				18.6	19.5			
Bees	Vespidae			T									2.6	3.1				1.1	T			
Beetles	Crickets, etc.				15.8	20.5	18.2			3.0	21.4	2.3	T		19.9	19.5	19.7	T		20.7	20.5	20.6
Larvae	Maggots			2.2																		
Birds		BIRD	T	T	1	1	1	T	T	1	1	1				1	T			ø	ø	ø
Corn		GRAIN											T	T				T				
Oats	Avena sativa				1.0		1.0				2.5	1.3	3.9	6.3	6.5	14.1	10.3	11.6	7.6	14.8	19.1	17.0
Wild Oats													6.5	3.3					3.5			
Wheat	Triticum aestivum			T					2.5									2.2				
Barley	Hordeum vulgare			T										3.5					8.0			
Inorganic	Garbage, etc.	OTHER	2.7	T	2.7	T	1.4	2.0		2.0		1.0	T	3.1	8.1	7.8	7.9	T		2.2	ø	1.1
Honey +/- Wax	From Apiaries												1.7	4.7				2.2				

Common Name	Scientific Name	Class	FALL									
			STOMACHS					INTESTINES				
			Fem.	Male	Fem.	Male	Ave.	Fem.	Male	Fem.	Male	Ave.
Pine	Pinus spp.	VEGETATION	T					1.3				
Pulp												
Grasses	Gramineae		T	T				12.5				
Mulch			32.8	8.3				16.0	8.3			
Poplar	Populus tremuloides											
Willow	Salix spp.		T		35.8	9.3	22.0			29.8	8.3	19.0
Clover	Trifolium spp.											
Dandelion	Taraxarum officinale											
Horsetail	Equisetum spp.											
Sedges	Cyperaceae											
Honeysuckle	Lonicera dioica											
Alfalfa	Medicago sativa											
Cranberry	Viburnum opulus	WILD FRUITS	3.11	1.0				18.3	1.1			
Rosehips	Rosa spp.			T					T			
Chokecherry	Prunus virginiana		11.1	32.5				11.6	34.4			
Hazelnuts	Corylus cornuta											
Dogwood	Cornus stolonifera		25.2	11.3				14.6	10.0			
Sarsaparilla	Aralia nudicaulus		T	T	40.4	47.8	44.1			44.5	46.5	46.0
Saskatoon	Amelanchier alnifolia											
Strawberry	Fragaria virginiana											
Nannyberry	Viburnum lentago			T								
Buffaloberry	Shepherdia canadensis											
Wild Plum	Prunus americana											
Muskrat	Ondatra zibethicus	ANIMALS										
Squirrel												
Rabbit	Lepus americanus											
Fish												
Pork	Bait		5.0	T	5.0	2.0	3.5		T	ø	1.0	T
Bear	Bait/Grooming			T								
Beaver	Bait (Castor spp.)											
Beef	Bait											
Moose	Alces alces											
Deer	Odocoileus spp.											
Ants	Formicidae	INSECTS	6.1					6.1				
Bees	Vespidae		6.7	8.9	6.7	11.9	9.3	8.9		ø	15.0	7.5
Beetles	Crickets, etc.											
Larvae	Maggots											
Birds		BIRD			ø	ø	ø			ø	ø	ø
Corn		GRAIN	T									
Oats	Avena sativa		T	5.0	11.4	17.9	14.6		5.6	13.3	20.1	14.6
Wild Oats			3.9	2.8				3.3	2.8			
Wheat	Triticum aestivum		6.5	9.7				10.0	11.1			
Barley	Hordeum vulgare			1.7								
Inorganic	Garbage, etc.	OTHER	T		2.7	5.6	4.1			6.6	8.9	7.7
Honey +/- Wax	From Apiaries		1.7	8.9				6.6	8.9			

APPENDIX II

APPENDIX IIa. Prevalence of intestinal parasites by season and sex of bears.

	SPRING		SUMMER		FALL		TOTAL	
	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	Male
# carcasses studied	14	29	9	12	6	9	29	50
# carcasses infected	2	1	6	5	6	4	14	10
# parasites found	17	1	40	86	56	54	113	141
# parasites per host	1.2	Ø	4.4	7.2	9.3	6.0	3.9	2.8
# parasites per infected host	8.5	1.0	6.7	17.2	9.3	13.5	8.1	14.1
Prevalence (%)	14	3	67	42	100	45	48	20

APPENDIX IIb. Distribution of intestinal parasites by section of gut.

	FRONT 1/3		MID 1/3		REAR 1/3		STOMACH		TOTAL	
	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	Male
Fall										
# parasites found	29	26	19	27	8	1	Ø	Ø	54	56
Distribution	51.8	48	33.9	50	14.3	2	Ø	Ø	99.9	100
Summer										
#parasites found	29	47	10	31	1	7	Ø	2	40	87
Distribution	72.5	54	25	35.6	2.5	8	Ø	2.3	100	100
Spring										
# parasites found	10	Ø	7	1	Ø	Ø	Ø	Ø	17	1
Distribution	58.8	Ø	41.1	100	Ø	Ø	Ø	Ø	100	100